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The Open Court

A MONTHLY MAGAZINE

Devoted to the Science of Religion, the Religion of Science, and the Extension of the Religious Parliament Idea

Founded by Edward C. Hegeler

BEL MERODACH AND THE DRAGON.
From a Babylonian monument. The god's hands are reversed. (See pages 17 and 19.)

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PROF. ERNST MACH OF VIENNA.
From a recent photograph.

Frontispiece to The Open Court.

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MEMORY. REPRODUCTION AND ASSOCIATION.

BY ERNST MACH.[1]

ON a walk through the streets of Innsbruck, I meet a man whose face, form, walk, and way of speaking stimulates in me the vivid thought of such a face, walk, and so on in different surroundings —on the banks of the Lake of Garda. I recognize the man A, who appears to me as a sense-experience in the present surroundings, to be the same man who makes a part of my recollection with the surroundings R. The recognition, the identification, would have no meaning if A were not given *twice*. Presently conversations with A in R occur to me, I recollect expeditions which I took in his company, and so on. Similar facts which we observe on the most varied occasions can be grouped together in a rule: a sense-experience with the parts A B C D .... brings to remembrance an earlier sense-experience with the parts A K L M ...., that is to say, the latter idea enters, it is reproduced. Now, since the reproduction of K L M .... by B C D .... does *not* follow generally, we naturally conclude that K L M .... is introduced by the common part A and proceeds from it. On the reproduction of A depends that of K L M .... and the parts K L M .... were given by the senses *simultaneously* (in temporal contact) with A either directly or with other already reproduced terms. All the processes connected herewith can be reduced to this *single law of association.*

Association is of great biological importance. Every psychological adaptation to surroundings, every common and also every

[1] Translated from *Erkenntnis und Irrtum* by Philip E. B. Jourdain.

scientific experience rest on it. If the surroundings of living beings did not consist of parts which remain at least approximately constant or could be analyzed into periodically recurring events, experience would be impossible and association valueless. Only if the environment remains unchanged can the bird connect the *visible* part of its surroundings with the notion of the locality of its nest. Only if the approaching enemy or the flying prey is always announced by the same noise, can the associated idea cause the reaction of a corresponding readiness for either flight or attack. An approximate stability makes experience possible, and inversely the actual possibility of experience allows us to conclude as to the stability of the surroundings. The *result* justifies our supposition of constancy[2] as based on *scientific method.*

A newly born child is thrown on its own reflex movements, like an animal of lower organization. It has the inborn impulse to suck, to cry if it needs help, and so on. As it grows up it, like the higher animals, acquires the first primitive experiences by association. It learns to avoid the contact of fire and knocking against hard bodies, as these are painful; it learns to connect the notion of the taste of an apple with its appearance, and so on. But soon it leaves all animals far behind it in the abundance and the refinement of its experiences. It is very instructive to observe the formation of associations in young animals, as C. Lloyd Morgan[3] has systematically done with young chickens and ducks hatched in an incubator. The chickens are provided with suitable reflex movements only a few hours after hatching. They run about, peck at whatever attracts their attention and never miss it. Even little partridges may be seen running about while still partly covered with shell. At first the young chickens pecked at everything, at the letters of a printed page, at their own toes, at their own excrements; but in the last case the chicken immediately threw away the ill-tasting thing, shook its head and cleaned its beak by scraping it on the ground. The young bird behaved in a similar way when it took hold of a bee or a caterpillar that had a bad taste, but the pecking at unsuitable and useless objects soon stopped. The chickens left a saucer of water unnoticed, but they drank immediately when in running about their

[2] Experience has taught us to know stabilities, our psychical organization easily adapts itself to them, and gives us advantages. We introduce the supposition of further stabilities consciously and at will, in the expectation of further advantages, supposing this expectation to hold good. The supposition of an *a priori* conception for the founding of this methodical procedure is neither necessary to us nor would it be of any use to us. It would be preposterous in view of the evidently empirical formation of this conception.

[3] *Comparative Psychology,* London, 1894, pp. 85 ff.

feet happened to get into the water.[4] Young ducks, on the contrary, plunged at once into the saucer of water, washed themselves in it, dipped under the water, and so on. When on the next day this saucer was offered to them *empty*, they again plunged into it and carried out the same movements as in the water, but they soon learned to distinguish between the empty saucer and the full one. I myself once put a drinking-glass over a chicken which had been hatched out several hours and put a fly into the glass with it. Immediately a very amusing but fruitless chase began, for the chicken was not clever enough to catch the fly.

The habits of chickens and ducks are inborn in the young, who practise them at once without being taught. They are prepared for by the mechanism of movement, just as are the sounds the fowls make. We can distinguish in chickens the sound of contentment when they creep into a warm hand; the cry of danger at the sight of, say, a big black beetle; the cry of loneliness, and so on. But however much is mechanically prepared and innate in these creatures, and however much the accomplishment of certain associations may be anatomically favored and made easy, *the associations themselves are not innate but must be acquired by individual experience.*

This will be correct if we apply the word "association" only to (conscious) notions. If we take it in the wider sense of a reaction of simultaneous organic processes upon one another, then it is very difficult to draw the line between what is innate (inherited) and what is individually acquired. And this must be the case if the acquirements of the species are to be increased or modified by the individual. My tame sparrow knows no fear, perches on the shoulders of the members of my family, tugs at hair and beard, defends itself boldly and with angry chattering against the hand which tries to drive it from the shoulder of a privileged person; and yet its wings quiver nervously at every noise and at every movement near it. When it takes little bits from the dining-table, it flies off with each one, even though only a foot away, just like its companions in the street, although it is not disturbed by any acquaintances.

Young chickens which have been brought up in an incubator do not notice the clucking of the hen, neither do they fear a cat or a hawk. If young kittens before their eyes are opened should actually spit when taken up by a hand that has stroked a dog, then

[4] But birds deprived of the cerebrum behave in the same way. The phenomenon thus rests on reflex acquired from ancestors. [Cf. the end of this chapter. Cf. also Mach, *Contributions to the Analysis of the Sensations*, Chicago, 1897, p. 377.—Tr.]

we must suppose this to be a *reflex* of the sense of smell.[5] Young animals to be sure are easily frightened by unusual appearances. Thus, young chickens which were fed on small worms would occasionally swallow also twisted bits of wool, but stood in doubt before a large piece. A tame young sparrow for a long time distrusted its food-dish, when, by way of experiment, a big meal-worm had been put in it.[6] The fear of what is unusual or striking in the case of many animals appears to be one of the most important means of protection.

In the more highly developed animals we can perceive the formation of associations still more strikingly, and at the same time substantiate their durability. In the village in which I passed part of my youth, many dogs, teased by the children of the village, had fallen into the habit of running away on three legs and whining as soon as any one took up a stone from the ground. One was naturally inclined, from a human point of view, to take this for a cunning trick to excite sympathy, but evidently it was only a lively associated remembrance of the pain which had sometimes followed the picking up of a stone. I once saw a young hound which belonged to my father impetuously root out an ant heap, but immediately clean his sensitive nose with his paw in a puzzled manner. From then onwards he carefully respected ants' nests. When once this hound persistently disturbed me in my work by his undesired and exaggerated attachment, I closed a book with a loud bang in front of his nose. He drew back frightened. Thereafter the seizing of a book was enough to keep him from disturbing one. Judging from the play of his muscles in sleep, this dog must also have had a vivid imagination in dreams. Once when he lay sleeping quietly, I brought a little piece of meat near his nose. After some time a lively play of muscles began, especially of the nostrils. After about half a minute the dog woke up, snapped up the bit of meat, and then quietly went to sleep again. I was also able to convince myself of the durability of this same dog's associations. When I came back unexpectedly in the dark and on foot to my father's house after nine years absence, the dog received me with furious barking; but a single call was enough to turn this at once into the most friendly behavior. Hence I consider the Homeric story of Odysseus's dog to be no poetical exaggeration.[7]

[5] Schneider, *Der tierische Wille*, Leipsic, 1880.

[6] Observed by my daughter.

[7] Next to the writings of Morgan, K. Möbius, *Die Bewegungen der Tiere und ihr psychischer Horizont* (Schriften des naturwissensch. Vereins für Schleswig-Holstein, 1873) on the psychology of lower and higher animals is very instructive. Further cf. A. Oelzelt-Newin, *Kleinere philos. Schriften; Zur*

The importance for psychical development of the comparison of a sense-experience A B C D .... with a sense-experience A K L M ....reproduced in thought cannot be estimated highly enough. The separate letters may signify whole complexes of elements. A may be, for example, a body which we have once come across in the surroundings B C D ... but now meet in the surroundings K L M ...—say a body which moves across its back-ground—and by this means is recognized as a special image of relative *independence*. If now we give the signification of single elements (sensation) to single letters, we learn to know these elements as *independent component parts* of our experience; for example, not only an orange is suggested to us by the red-yellow A, but also a piece of cloth, a flower, or a mineral; thus it enters into *different* complexes. However, not only *analysis* but also *combination* depends on association. For example let A denote the visual image of an orange or of a rose, while K in the reproduced complex denotes respectively the taste of the orange or the smell of the rose. Immediately we associate the already tested properties with the newly apparent visual image. The notions we receive from the things that surround us do not therefore correspond exactly to the actual sensations, but are as a rule much richer. There are whole bundles of associated ideas which, arising from previous experience and becoming complicated with the actual sensations, determine our behavior to a far greater extent than could the sensations alone. We not only see a red-yellow ball, but think we perceive a soft, fragrant and refreshingly acid bodily thing. We do not see a brown vertical shining surface, but, say, the wardrobe. But for this reason we can sometimes be misled by a yellow ball of wood, a painting, or a reflection in a mirror. As we grow older, the variety and richness of our sense-experience increases as well as the number and variety of the associative connections between the experiences. As we have seen, we thus come both to a progressive resolution of these experiences into parts and also to a continual formation of new syntheses from them. After the intellectual life becomes matured, *thought-complexes* can behave with respect to one another in the same productive and associative manner as sense-experiences. In the thought-complexes new analyses and syntheses will also occur, as every romance and every scientific work teaches and as every thinker can observe in himself.

Psychologie der Seesterne, Vienna, 1903. Of earlier writings I may recommend: H. S. Reimarus, *Triebe der Tiere*, 1790; J. H. F. Autenrieth, *Ansichten über Natur- und Seelenleben*, 1836.

Although, now, only one principle of reproduction and association can be found, namely that of *simultaneity,* yet the thought-process assumes very different characters in different cases. This will be made clear by the following considerations. Most ideas have associated with many others in the course of their existence, and these associations, branching off in various directions, are to some extent in opposition and weaken one another. If, now, some of those which converge to *the same* point do not maintain the preponderance or are not specially favored by chance, then these associations will not be effective. For instance, can any one say when and where he has used or seen used or learned to know a definite letter, a word, a concept, or a way of counting? The more frequently he uses these devices and the more familiar he is with them, the less will he be able to do so. The name "Smith," even in this definite orthography, is so variously connected with different trades and occupations that by itself it gives rise to no association at all. According to my momentary direction of thought or occupation it may remind me of a philosopher, zoologist, historian, archeologist, mechanician, and so on. We can also observe this in rarer names. I often went past an advertisement of Maggi's meat-extract and only *once,* and then when I was thinking of physics, did it remind me of a man of the same name who wrote a book on mechanics which is interesting to me.[8] Thus, too, the blue color of a piece of cloth will suggest nothing of itself to a grown-up person, whereas it may remind a child of the cornflower which he picked yesterday. In connection with the name "Paris," there may occur to me the collections of the Louvre, or the city's renowned physicists and mathematicians, or its fine restaurants, according as I am inclined to the pleasures of art, scientific occupation, or culinary delights. Circumstances which stand in no material relation to the direction of thought entered upon may also be decisive. In this way Grillparzer is reported to have remembered a poetical sketch which he had quite forgotten owing to a long illness, when he again played the symphony which he had played when engaged upon that sketch. Jerusalem shows from a case[9] reported by him that associations can be induced through unconscious intermediate terms. The principle of *simultaneity* is expressed in these cases very clearly and distinctly.[10]

[8] [G. A. Maggi, *Teoria delle movimento dei corpi,* Milan, 1895.—Tr.]

[9] Wundt's *Philosophische Studien,* Vol. X, p. 323.

[10] That not all psychical events can be explained by temporarily acquired (conscious) associations, will be discussed later. Here we are concerned with *what* is made comprehensible by association.

Let us now consider some types of the thought-process.[11] If I, without any plan or purpose, and shut off as far as possible from outer disturbances—say in a sleepless night—quite give myself up to my thoughts, then it happens that they ramble over all sorts of subjects. Comic and tragic situations that I have remembered or divised mingle with scientific incidents and plans of work, and it would be very difficult to point out the petty chances which in each moment have given direction to this "free imagination." Not very differently do ideas arise when two or more persons are talking without constraint to one another, except that here the thoughts of several persons influence each other. The surprising leaps and turns of conversation often give rise to the wondering question: Well, how did *that* idea come up? The fixing of thoughts by spoken words and the number of observers makes the answer easier in this case, and only seldom does it fail. In dreams ideas pursue the most wonderful paths, but in this case the thread of association is very difficult to follow, partly on account of the incomplete remembrance which the dream leaves behind it, partly also on account of more frequent disturbance because of the great sensitiveness of the sleeper. Situations that have been experienced, forms that have been seen, and melodies that have been heard in a dream are often very valuable for *artistic* creation;[12] but the scientific *investigator* can make use of dream-thoughts only in the rarest cases.

Lucian's priceless Münchhausen-like tales do not quite correspond to the type of *free* imagination. This most talented writer of the ancient world here maintains on *principle* only the most adventurous and unlikely of his incidents. He speaks of huge spiders which connect the space between the moon and the morning-star with a web that can be used as a pathway and jokingly assigns liquid air as a drink to dwellers in the moon, 1700 years before it was really known. It is a plan of travel on which, as a guiding thread, he strings his imaginations. This journey brings him to the island of dreams, whose indefinite and inconsistent nature he characterizes wonderfully by saying that the nearer the traveler approaches to it the farther it recedes. In spite of this richly luxuriant imagination, the threads of association can be found wherever they are not purposely hidden. The journey begins at the Pillars of

[11] James, *The Principles of Psychology,* Vol. I, pp. 550-604.

[12] Well-known cases of this kind are the following: Voltaire dreamed a complete and varied canto of the Henriade. Still more remarkable is it that in a dream of Tartini's the devil played the theme of a sonata which the artist had not composed in waking moments;—if poetry and truth have not made a compromise in this story.

Hercules and goes westward. After eighty days the traveler reaches an island containing a memorial column and an inscription to Hercules and Dionysus, as well as the huge footprints of both gods. Of course there is a river on the island which contains *wine,* and fish the eating of which makes people intoxicated. The sources of this river spring from the roots of a luxuriously growing vine on whose branches are women who, like Daphne, have been partly changed into vines. Here the thread of association has swollen to a strong rope. At other places the author has even cut away shoots and flowers of his imagination which did not suit his esthetic and satirical purpose. By this rejection of what is useless, the intellectual life expressed in a literary or other equally free work of art differs from aimlessly giving oneself up to his own thoughts.

If I come to a place and into surroundings in which I spent a part of my youth, and if I simply give myself up to the impressions that these surroundings make on me, then *another* type of thought-process results. What is there offered to my senses is in so many ways associated with the experiences of my youth and is connected so weakly or not at all with later incidents, that little by little *all* the events of that period of my life emerge from forgetfulness with complete fidelity and in firm connection with one another in consecutive arrangement of time and space. In such a case, as Jerusalem[13] pertinently remarks, one always discovers himself to be a participant. Hence we can string the elements of remembrance in a temporal order on the thread of the person. A similar thing happens, though less completely, when the picture of my home arises in my mind, provided that the picture is not disturbed and is given time to complete itself. The tales every one has heard old people tell of their youth, or their account of summer holidays and their experiences in them, in which the slightest incident is not left out, are examples of this type.

The foregoing case was essentially concerned with the *revival* of already existing connections of ideas, that is, with simple recollections; whereas the solving of a conundrum or other riddle, of a geometrical or technical problem of construction, or of a scientific question, or the carrying out of an artistic subject, and so on, requires a thought-action with a definite end and object.[14] In this case something *new,* at the time only partly known, is *sought.* This thought-action, which never loses sight of the more or less circumscribed purpose, we call *reflection.* If a person who gives

[13] Jerusalem, *Lehrbuch der Psychologie,* 3d ed., Vienna, 1902, p. 91.

[14] [Cf. *Popular Scientific Lectures,* Chicago, 3d. ed., 1898, p. 277.—T.]

me a riddle or puts a problem to me is standing before me, or if I am sitting at my desk on which I already see the traces of my materials for work, in this way a complex of sensations is provided which always brings back my thoughts to the end in view and prevents their aimless wandering. This limitation of thought from the outside is not to be underestimated even for its own sake. If with a scientific problem in my mind, I finally go to sleep tired out, then immediately the external reminder and indicator to the goal is lacking and my thoughts become diffused and leave the proper path. This is one reason why the solution of scientific problems is seldom helped in dreams. But if the involuntary interest in the solution of a problem is strong enough, then the reminders from outside are quite superfluous. Everything that one thinks and notices then leads back of itself to the problem, at times even in a dream.

The idea sought in reflection has to fulfil certain conditions. It has to solve a riddle or a problem or to make a construction possible. The conditions are known but not the idea. In order to explain the kind of thought-movement which leads to finding what is looked for, we will choose a simple geometrical construction. The form of procedure is the same in all the cases coming under consideration here, and *one* example is enough to make all cases comprehensible. Two mutually perpendicular straight lines *a* and *b* (Fig. 1) are cut by any oblique third line *c*. In the triangle thus arising, a square is to be inserted whose angular points are placed on *a*, *b*, the point of intersection of *a* and *b*, and on *c*. We now *try* to represent to ourselves and construct squares which fulfil all these conditions. Three angles are enough to satisfy the conditions if we let one angle of any square coincide with the point of intersection of *a* and *b* and two sides of the square with *a* and *b*. But the fourth angle does not fall directly on *c*, but inside or outside the triangle. If, on the other hand, we take one angular point anywhere on *c*, the rectangle thus formed is not generally a square. But we see that from a rectangle with greater vertical sides we can pass over to a rectangle with greater horizontal sides by the choice of the angular point on *c*, so there must be an intermediate one with equal sides. Thus we can select the square with any approximation we wish, from among the series of inscribed *rectangles*. But there

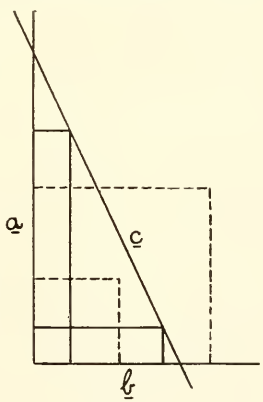

Fig. 1.

is still another way. If we start from a square whose fourth angular point falls inside the triangle and increase it till this angle falls outside, it must in this way pass through *c*. Thus a square of the correct magnitude can be selected with any desired approximation among the series of squares. Such tentative soundings of the realm of ideas where we must seek for the solution of the problem, naturally precede the complete solution. Ordinary thought may content itself with an approximate solution which is sufficient for practical needs. Science demands the most general, the shortest and the most lucid solution. We obtain this by recollecting (starting from the consideration either of the rectangles or of the squares) that all inscribed squares have as common diagonals the angle bisector proceeding from the point of intersection of *a* and *b*. Thus, if we draw this angle bisector from this *known* point, we can complete the desired square simply by finding the point of intersection of this bisector with *c*. Though this example is very simple—it is intentionally chosen as such and very fully discussed—it makes us clearly conscious of the essential part of the solution of every problem, namely, *experimentation with thoughts and with recollections*, as well as its identity with the familiar solution of riddles. The riddle is solved by means of a notion which shows properties corresponding to the conditions A B C .... *Association* affords us a series of notions of the property A, of the property B, and so on. The term or terms which belong to *all* these series—in which all these series meet—solves the problem. We will return at still greater length to this important subject. Here it is only our intention to explain that type of thought-process called *reflection*.[16]

What has preceded puts beyond doubt the importance of reproducible and associable traces of recollection of sense-experiences for our whole psychical life, and shows at the same time that psychological and physiological researches cannot be separated from one another, since even in the *elements* of the experiences relations of both kinds are most closely connected.

Reproducibility and associability also form the basis of "consciousness." The unintermittent subsistence of an invariable per-

[16] We may be tempted to consider that "active" reflection is essentially different from the "passive" leaving of our thoughts to take their own course. But, just as we are not masters over the sensations and recollections which are liberated by some act of our bodies, so we have no power over a thought of direct or indirect biological interest which is always reappearing and to which new series of associations are always being joined. Cf. my *Populär-wissensch. Vorlesungen*, 3d ed., pp. 287-308 [*Popular Scientific Lectures*, 3d ed., Chicago, 1898, pp. 259-281].

ception will hardly be said by anybody to be consciousness. Hobbes[17] says, "Always to perceive the same object and not to perceive at all come to the same thing." Nor is it evident what is to be attained by the assumption of a special "energy of consciousness" different from all other physical energies. That would be an assumption which would have no function at all—would be unnecessary—in the province of physics, and in the province of psychology would make nothing clearer. Consciousness is no *special* (psychical) *quality* or class of qualities, which differs from physical qualities; nor is it a special qualitiy which must be added to the physical ones in order to make conscious what is unconscious. Introspection as well as observation of other living beings to which we must ascribe consciousness analogous to our own, shows us that consciousness has its roots in *reproduction* and *association,* and that the height of consciousness runs parallel to the richness, fluency, rapidity, vitality, and arrangement of these functions. Consciousness does not consist in a special quality, but in a *special connection* of given qualities. We must not wish to explain sensation. It is something so simple and fundamental that its reduction to something still more simple cannot be successful, at least not at present. A single sensation is neither conscious nor unconscious. It becomes conscious by classifying it with the experience of the present time.[18]

Every disturbance of reproduction and association is a disturbance of consciousness, and can manifest all degrees from complete clearness to entire loss of consciousness in dreamless sleep or in a fainting fit. Temporary or lasting disturbance of the connection of the cerebral functions is also a temporary or lasting disturbance of consciousness. Comparative anatomical, physiological and psychopathological facts necessitate the supposition that the integrity of consciousness is conditioned by that of the cerebral lobes. Different parts of the cerebral cortex show traces of different sense-excitations, definite parts show those of the optical sensations, others of the acoustical, others of the tactile, and so on. These different cortical areas are connected with one another in numerous ways by means of the *fibers of association.* Psychical disturbances follow every cesssation of the function of an area of the cortex and every inter-

[17] *Sentire semper idem et non sintire ad idem recidunt;* Physica, IV, 25.

[18] Whoever thinks that he can build up the world from consciousness has not made it clear to himself what sort of a complication the fact of consciousness includes. A very condensed and valuable discussion of the nature and conditions of consciousness is to be found in Wernicke's *Gesammelte Aufsätze,* Berlin, 1893 (on consciousness, see pp. 130-145). Cf. also the lectures of Meynert cited in the following note.

rupted connection.[19] Without going into many details, we will illustrate this by typical examples.

The notion of an orange is an extremely complicated thing. Form, color, taste, smell, touch, and so on are interwoven in a peculiar way. If I hear the *name* "orange" this train of acoustic sensations drags forward the whole bundle of the above notions as if by a thread. In addition to this there follows, as a consequence of the name which has been heard, the remembrance of the sensations experienced at the sound of the name, and also the remembrance of the sensations of the motions of writing the word and the visual form of the written or printed word. Accordingly, if there are in the brain special optical, acoustical, and tactile areas, and if one of these is eliminated by the suppression of its function or the removal of its association with the remaining areas, peculiar phenomena appear. Such have actually been observed. If the optical or the acoustical area continues to function while its associative connections with other, important fields cease to function, then "mental blindness" (*Seelenblindheit*) or "mental deafness," which Munk has observed in dogs by operations on the cerebrum, respectively arise.[20] Such dogs *see* but do not *understand* what they see; they do not recognize their food-dish, the whip, or a threatening gesture. In the case of mental deafness the dog *hears* but pays no attention to the well-known call—it does not *understand* it. The observations of physiologists are here supplemented and confirmed by those of psychopathologists. The study of disturbances of speech[21] is especially productive here. The meaning of a word lies indeed in the crowd of associations which the word calls up and the correct use of it rests inversely on the existence of these associations. Disturbances of the latter must express themselves here in a striking way. Most people are *right*-handed, and thus use the *left* hemisphere of the cerebrum for finer work and also for speech. Broca recognized the importance of the hinder part of the third left brain-convolution for articulate speech. Speech is always lost when this part of the brain becomes ill (apoplexy). Loss of speech (aphasia)

[19] Meynert, *Populäre Vorträge,* Vienna, 1892, pp. 2-40.

[20] It can hardly be doubted that there is a difference in the work performed by different parts of the brain. But if, as Goltz has shown, a part of the cerebral cortex can by degrees replace the others, an *abrupt* delimination of functions is not to be thought of, but only a "gradual localization" in the sense of R. Semon (*Die Mneme,* Leipsic, 1904, p. 160). Cf. also *Analyse der Empfindungen,* 1886, p. 82, 4th and 5th ed., p. 165. [*Contributions to the Analysis of the Sensations,* Chicago, 1897, pp. 112, 115, 116. The full title of R. Semon's book is: *Die Mneme als erhaltendes Prinzip im Wechsel des organischen Geschehens,* and a third edition was published in 1911.—Tr.]

[21] Kussmaul, *Störungen der Sprache,* Leipsic, 1885.

can also be conditioned by very many different defects. For example, the patient remembers words as sound-images and can also make them known by means of writing, yet cannot speak the words in spite of the mobility of the tongue, lips and so on; the *motor* word-image is lacking and does not liberate the suitable movement. The optical or motor *writing-image* may also be lacking (agraphia). The ideas may be present while the auditory word-image is lacking. It may also happen the other way round that the spoken or written word is not understood—gives rise to no associations—and then we have *word-deafness* or *word-blindness.* Such a case of word-deafness and word-blindness with an intelligence otherwise unimpaired Lordat himself experienced and after his cure was able to give an account of it. He movingly describes the moment when, after many sad weeks, he noticed on the back of a book in his library the words *Hippocratis opera,* and could again read and understand them.[22] Even after this summary and by no means complete and detailed account of the cases here presented, we can estimate how many paths of connection between the sensory and motor areas come into consideration.[23] Lesser disturbances of speech, as expressed by mistakes in writing and speaking, appear as consequences of temporary weariness and preoccupation among quite healthy people. Thus someone cited the two chemists Liebig and Mitscherlich as "Mitschich and Liederlich." Another called a *Magister der Pharmacie* a *Philister der Magie.*[24]

An interesting case of mental blindness is reported by Wilbrand.[25] A very cultured and well-read merchant enjoyed an extraordinary visual memory. The features of the people whom he remembered, the forms and colors of objects of which he thought, and theatrical scenes and landscapes he had seen, appeared before him in complete clearness with every detail. He could read from memory parts of letters and several pages from his favorite authors, for he saw the text before him with all its details. His memory for auditory impressions was small and his sense of music was lacking.

[22] Kussmaul, *op. cit.,* p. 175.

[23] Kussmaul, *op. cit.,* p. 182.

[24] On curious disturbances among musicians, analogous to aphasia and agraphia, cf. R. Wallaschek (*Psychologie und Pathologie der Vorstellung,* Leipsic, 1905).

[In the text, we have had to leave the German words to tell their own tale, as the point would obviously be lost in an English translation. English equivalents are the probably mythical utterances, called "Spoonerisms," of a certain Oxford professor. Thus, instead of: "We are all standing on the same dead level," the professor is reported to have said: "We are all standing on the same lead devil."—Tr.]

[25] Wilbrand, *Seelenblindheit,* Wiesbaden, 1887, pp. 43-51.

Heavy cares, which proved to be unfounded, were followed by a time of confusion, and this again by a complete change in his psychical life. His visual memory was completely lost. A town to which he often returned appeared new to him every time. The features of his wife and children were strange to him, and he even looked upon himself as a strange person when he saw his reflection in a looking-glass. If he now wished to reckon—an operation which he formerly performed by visual images—he had to pronounce the numbers, and he was likewise obliged to have recourse to auditory images and images of motions of speech and writing in order to note phrases or to remember what was written. No less remarkable is another case of loss of visual memory.[26] A lady had a sudden and violent fall. Afterwards she was supposed to be blind since she did not recognize any one around her. But the fall, besides restricting her field of vision which gradually improved, left only the loss of visual memory of which the patient was fully conscious. She made the characteristic comment: "To judge from my condition, we see more with our brains than with our eyes; the eyes are merely the means for seeing; for I see everything clearly, but I do not recognize it and often do not know what I see.[27]

In the light of the above cases, we must say that there is not *one* memory but that memory is made up of several *partial memories* which are separated from one another and can be separately lost. To these partial memories correspond different parts of the brain, some of which can even now be localized with a fair degree of accuracy. Other cases of the loss of memory seem more difficult to reduce to a principle. We will only consider some of them which Ribot[28] has collected.

A young woman, who passionately loved her husband, fell in childbed into a prolonged unconsciousness and as a consequence of this her memory of the time of her marriage entirely vanished while her memory of her earlier life up to her marriage remained quite unimpaired. Only the witness of her parents led to the acknowledgment of her husband and child. The loss of memory in her case remained irreparable. Again, a woman fell into a torpor which lasted for two months. After she woke up she knew nobody round her and had forgotten everything she had learned. Easily and in a short time she learned everything again, but without any

[26] Wilbrand, *op. cit.*, p. 54.

[27] Wilbrand, op. cit., p. 57.

[28] *Les maladies de la mémoire,* Paris, 1888. English edition, Chicago, The Open Court Publishing Co., 1898.

remembrance that she had known it before. Yet again, a woman fell by chance into some water and was nearly drowned; when she opened her eyes she did not recognize her surroundings and had lost her speech, hearing, smell, and taste. She had to be fed. She daily began to learn anew and her condition gradually improved. She remembered a love-affair and her fall into the water and was cured by jealousy.

Periodic losses of memory are the most remarkable. After a long sleep, a woman had forgotten everything she had learned. She had to learn again how to read, reckon, and become acquainted with her surroundings. After some months she had another deep sleep. When she awoke, she found herself in possession of memories of her youth just as before her first sleep, but had forgotten what had occurred between the two periods of sleep. From then onwards for four years the two states of consciousness and memory were repeated periodically. In the first state she had beautiful handwriting; in the second, a poor one. People whom she was supposed to know permanently had to be introduced to her in both states. This case is illustrated by one often quoted of a servant who lost a parcel when he was drunk and could only find it again when he was in a second drunken fit. In a waking state one remembers even one's vivid dreams with difficulty, and inversely in dreams the conditions of a waking state mostly quite vanish from us. On the other hand the same situations often enough repeat themselves in a dream.[29] Finally every one can notice for himself, even when he is awake, the changes of moods with which the experiences of different periods of his life come into consciousness in quite different degrees of vividness. All these cases form a continuous passage from the sharp separation of different states of consciousness to almost complete effacement of the boundary. These cases can be considered as examples of the formation of different *centers of association* round which the masses of ideas group themselves when favored by time and mood, while these masses show no degree of connection, or only a small one, with one another.[30]

If, with Hering,[31] we attribute to the organism the property of

[29] [A friend of mine dreamed that he was buying things in a shop. In the dream he suddenly became conscious of the fact that he had forgotten what to buy next and could only remember if he woke up. So he woke up, remembered, and then went to sleep and continued *the same* dream.—Tr.]

[30] With reference to such periodical disturbances of memory, observations like those of Swoboda (*Die Perioden des menschlichen Organismus,* 1904) do not appear so adventurous as they do at first sight.

[31] [*On Memory and the Specific Energies of the Nervous System,* Chicago, 1895.]

adapting itself better successively as events are repeated, then we recognize what we commonly call memory to be a partial phenomenon of a *general* organic phenomenon. It is the adaptation to periodic events in so far as it directly comes into consciousness. Heredity, instinct, etc., may then be characterized as memory stretching out beyond the individual. In R. Semon's book *Mneme,* above cited, appears the first endeavor to investigate and to clarify scientifically the relation between heredity and memory.[32]

[32] Detto ("Ueber den Begriff des Gedächtnisses in seiner Bedeutung für die Biologie," *Naturwiss. Wochenschr.,* 1905, No. 42). The author will hardly admit that Hering or Semon fall into the faults denounced by him. The advantages of the investigation of what is organic from *two* sides he appears to me to underestimate. *Psychological* observation can reveal to us the existence of *physical* events the knowledge of which we could not attain so soon by a physical way.